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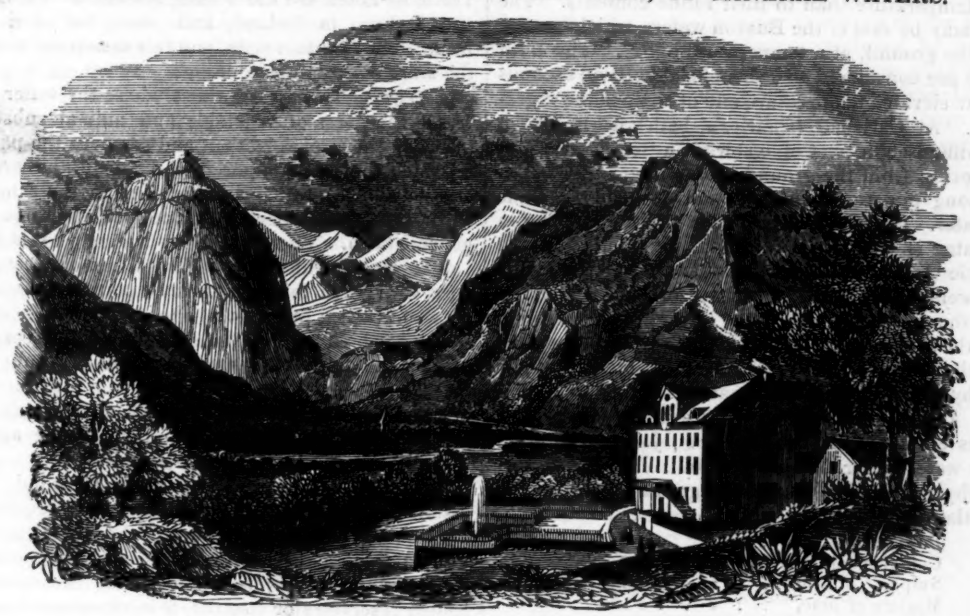
ON THE GENERAL LOCALITIES, NATURE, AND USES, OF MINERAL WATERS. II.



THE BATH-HOUSE OF STACHELBAD, CANTON OF GLARUS, SWITZERLAND.

IN the preceding details we have not noticed the difference of temperature in different springs, but have spoken of them with reference to their chemical ingredients; we must, however, shortly allude to those springs, in which an elevated temperature is the most distinguishing feature.

At Wiesbaden, the capital of Nassau, is a most remarkable spring, or rather assemblage of springs, the temperature of which is 140° at all seasons of the year, and which retain their heat longer than any other water of the same temperature. Dr. Granville and Sir F. Head both compare the fuming waters of Wiesbaden to "very hot chicken broth;" and the latter jocosely adds, "I do certainly wonder why the common people should be at the inconvenience of making bad soup, when they can get much better from nature's great stock-pot, *i. e.*, the koch-brunnen (boiling spring) of Wiesbaden." These "brothy" waters are used both as drink and as a bath. In the latter form they are described as presenting to the bather a surface of dirty-white thick froth, which is by no means inviting, but they have an invigorating effect on the frame. These waters are found to be detrimental in cases of inflammation or fever, but of advantage in a great many disorders of the system.

A milk-warm spring rises at Schlangenbad, in Nassau, which is described by Sir F. Head, as producing a delightful sensation on the skin, when used as a bath. The discovery of this spring, is said by the same amusing writer to have originated thus:—

Once upon a time, there was a heifer, with which everything in nature seemed to disagree. The more she ate, the thinner she grew; the more her mother licked her hide, the rougher, and the more staring was her coat. Not a fly in the forest would bite her: never was she seen to chew the cud; but, hide-bound and melancholy, her hips seemed actually to be protruding through her skin. What was the matter with her? no one knew; what could cure her? no one could divine: in short, deserted by her master and her species, she was, as the faculty would term it, 'given over.' In a few weeks, however, she suddenly reappeared among the herd, with ribs covered with flesh, eyes like a deer, skin sleek as a mole's, breath sweetly smelling of milk, saliva hanging in ringlets from her jaw.

The reader will guess the sequel: the animal had found the milk-warm spring, the waters of which had strengthened her. A young lady of the neighbourhood, being in a declining condition, was induced to drink the waters of this spring, which restored her. The celebrity of the spring then followed, as a matter of course. The water is sent in bottles to different parts of Europe; where it is used as a cosmetic. It has also the reputation of tranquillizing the nerves, and soothing inflammation. The salts contained in it are muriates and carbonates of lime, soda, and magnesia, with a slight excess of carbonic acid, which holds the carbonates in solution.

4. *Saline Waters,*—are nearly all those which do not belong to the preceding division; they generally contain some of the following salts, sulphates of lime, magnesia, and soda, and carbonates and muriates of the same bases. Saline springs exist at Epsom, Cheltenham, Dunblane, Seidlitz, &c. Cheltenham water contains in a wine pint

Sulphate of soda, ...	15 grains.
„ magnesia, . . .	11
„ lime, ...	4·5
Muriate of soda, ...	50
	80·5

The general medicinal character of saline water is that of being purgative when taken into the system.

Cheltenham, Leamington, and Scarborough waters are all of an aperient nature, as are likewise those of Seidlitz in Germany. Many of these saline springs have an elevated temperature, and are frequently designated *hot* springs. The Matlock water has a temperature of about 66°, and is valuable as a bath for persons of delicate constitution. The Bristol hot well has a temperature of 74°, and gushes forth at the rate of forty gallons per minute. The medicinal effect of the Matlock and Bristol waters is due more to their temperature than to their saline contents. The same may be said of the Buxton waters, which emerge from the ground, at a temperature of 82°. The Bath waters are considered to be beneficial both on account of their elevated temperature and of their saline ingredients. At Carlsbad (Charles's bath) in Bohemia, 192 million cubic feet of water, at a temperature of 64°, spring from the ground in one day.

Among mineral waters we may probably include sea-water. The proportion of saline matter existing in sea-water is subject to continual variation. In the Atlantic Ocean, within the tropics, the water contains one twenty-fourth of its weight of saline matters. From the great heat of those latitudes, evaporation from the surface must be extensive, while at the same time the influence of rivers in counteracting the saltness, by the addition of fresh water is scarcely appreciable. In colder climates, where evaporation is less, there is less salt in the water. We subjoin two analyses of sea-water by Dr. Marcet and Dr. Murray. The former physician found that in 500 grains of water from the Atlantic ocean there were:—

Pure water, ...	478·42 grains.
Common salt, . . .	13·3
Sulphate of soda, ...	2·33
Muriate of lime, ...	0·995
„ magnesia, ...	4·955
	500·

Dr. Murray found a pint of sea-water to contain:—

Muriate of soda, ...	159·3 grains.
„ magnesia, . . .	95·5
„ lime, ...	5·7
Sulphate of soda, ...	25·6
	286·1

Iodine and bromine have sometimes been detected in sea-water. Its specific gravity is generally 1·0277. The water of the Dead Sea contains as much as one-fourth of its weight of saline matters, and is of such a specific gravity (1·211) that a man may lie easily on its surface without sinking.

Dr. Russell says that sea-water is beneficial in obstructions of the glandular apparatus, in glandular swellings, in recent tumours of the joints, in diseases of the skin, and in obstructions of the liver and kidneys. The frequent recommendation of sea-bathing indeed sufficiently indicates the value in which it is held.

We may here state that many attempts have been made to convert sea-water into a state fit for drinking, by removing the salt, &c. Dr. Irving received 5000*l.* for a contrivance having this object in view. The water was put into a boiler, in the cover of which a pipe was fixed. A fire was applied to the boiler, and the outside of the tube was kept constantly wetted; by which the steam that passed through it was condensed into water. The salts contained in the water did not vaporize with it, and were therefore left behind. It was stated that the common fire and boiler of the ship might be used; and moreover that the steam arising from boiled provisions might be collected and condensed in the same manner. This proposal was first put into practical application by Captain Phipps (afterwards Lord Mulgrave) in his voyage to the North Pole in 1770. Sixty gallons of fresh water were procured from the boiler of the vessel during the cooking of the ship's provisions.

After a few remarks on the chemical effects of some springs, we shall briefly consider the results which sometimes follow from keeping water in metallic vessels.

Some springs contain a considerable quantity of siliceous earth in solution, but these are not common. The most noted are the boiling springs of the Geyser and Rykum in Iceland, and some hot springs in India. They contain soda, and this assists in rendering the siliceous earth soluble.

Petrifying springs are those where the water penetrates the pores of vegetable and animal substances placed in them, dissolves out and removes the particles of which they are composed, and substitutes earthy or stony particles, which are arranged in the same way as those of the former substances, and preserve their general form. There are many waters of this kind.

The rivers Danube and Pregal, in the course of ages convert in this manner into petrifactions stakes of wood placed in them. There are also incrusting springs, which deposit the earthy particles they contain in the form of a crust around any substances placed in them. Those earthy particles are carbonate of lime, held in solution by carbonic acid, which leaves the water when it becomes exposed to the air, and then the carbonate of lime is precipitated.

Our readers may perhaps call to mind many instances of poisoning by means of lead, recorded in the newspapers. The action of this metal upon the human frame is highly injurious, and since water is conveyed in leaden pipes, and stored occasionally in leaden reservoirs or cisterns, it is important to inquire whether water exerts any action upon lead so as to dissolve it, and in this way to get it introduced into our food.

This inquiry we may answer with a decided negative. Pure water exerts no action upon metallic lead; but there are certain gases which water nearly always holds in solution, which do attack lead, and the result of such action is a compound which is soluble in water. So that although water does not, in a direct manner dissolve lead, yet it does so indirectly, because all water employed for domestic use (except distilled water confined in close vessels), contains the gases to which we have alluded; viz., oxygen and carbonic acid. The oxygen to which we here allude, is not that which forms one of the constituents of water, but it is that which enters into the composition of atmospheric air, which water dissolves and holds in solution. That these gases are not chemically combined with the water, may be proved by placing a glass vessel of water under the receiver of an air-pump; on removing the pressure, the dissolved gases will be set free, and, forming myriads of bubbles, give a curious appearance to the water.

The Chemist, when he wishes to know whether a liquid possesses any *acid* properties, is not satisfied with the fact that it tastes *sour*. It is not necessary that he should appeal to his sense of taste (and in many cases it would be highly dangerous were he to do so); and moreover, the senses are at best but fallacious guides, since a slight, though decidedly acid taste to one person, may be quite inappreciable to another. The chemist has a test by which he is enabled to distinguish acids with precision, in consequence of a property possessed by all acids, (except a very few of rare occurrence,) of converting vegetable *blue* colours into *red*. A slip of paper is commonly adopted, stained by a vegetable substance called

litmus. When this paper is dipped into a solution containing free acid, (that is, acid not in chemical combination with another body,) the blue litmus paper is changed into red. Another property of acids is that of combining with alkalies, and in some cases forming neutral salts, or salts in which the acid and alkaline constituents are so nicely balanced, as to neutralize each other. But there is another property of acids which will bring us back to our subject. Acids dissolve the oxides of metals, but never the metals themselves. Thus:—green, white, and blue vitriol, are chemically called sulphates of iron, zinc, and copper; but in strictness, they are sulphates of the oxides of these metals: that is, iron united to oxygen, forms oxide of iron, and this is soluble in sulphuric acid, whereas pure iron is not.

Now in order to get a compound of lead which shall be soluble in water, the metal must first be oxidized; and atmospheric air (of which oxygen is a constituent part) is present in river and spring waters. This gas combines with lead, and forms oxide of lead, and the carbonic acid also present in the water, dissolves this oxide when it is formed; and the resulting compound is carbonate of lead, or white lead.

It is fortunate, perhaps, that carbonate of lead is but sparingly soluble in water, since it is so highly pernicious to animals. Indeed, the quantity dissolved is so exceedingly small, that very delicate tests are necessary to detect it. Water may be protected from adulteration by lead by dissolving in it so small a quantity as $\frac{1}{4000}$ of its weight of sulphate of soda (glauber salt), or $\frac{1}{3000}$ of phosphate of soda, or hydriodate of potash. When either of these substances is present in water contained in leaden vessels, the lead is at first covered with a very thin film of carbonate of lead, in the same way as if no protecting substance were present in the water. But a chemical action goes on between the carbonate of lead and the protecting substance, and the result is a decomposition of the carbonate of lead, and the formation of another substance entirely insoluble in water. The latter substance occupies the place of the film of carbonate of lead, and remains firmly attached to the surface of the leaden cistern; thus preventing all further action of oxygen on the metallic lead, and consequently, the carbonic acid has no oxide of lead to dissolve. Many river and spring waters contain salts which protect the water from lead, and such waters may be safely collected in leaden cisterns.

When cisterns are constructed of iron or zinc, oxides of those metals are formed, and dissolved by carbonic acid. A case of this nature came under the notice of the writer some time since.

At an inn, a few miles from the residence of the writer, a well, some years ago, had been dug through the chalk which forms the upper stratum of the soil for many miles round. From this well, the inn had been supplied with water drawn up by hand, until a recent period, when this primitive and laborious plan was superseded, and a pump constructed, the pump-box and pipes of which were of cast iron. A few weeks after the pump had been in use, the water was found to be discoloured by boiling, red flakes and a general muddiness were very apparent, and the water presented so unpleasant an appearance and taste, as to cause general complaint. The innkeeper naturally attributed this defect to the pump, and refused to pay for it. A dispute arising, it was determined that the water should be analyzed, in order to ascertain whether the pump affected the water, or the water affected the pump. If the latter were the case, it is clear that no blame could attach to the pump-maker, since the fault was not in his instrument, but in the corrosive nature of the water. A bottle of the water was sent to the writer for analysis; who found it to contain free carbonic acid gas, atmospheric air, and carbonate and sulphate of lime. The traces of iron were very marked, and this explained the discoloration of the water. The free oxygen in the water converted the surface of the iron into an oxide, which the carbonic acid dissolved, forming carbonate of oxide of iron; and water containing it, being boiled constantly in the same kettle, the iron was precipitated in the state of oxide, still, however, retaining a portion of its acid. This collecting at the bottom and sides of the kettle, was stirred up by the agitation produced by boiling. Carbonate of iron is, however, harmless when taken into the stomach; whereas, had the pump been formed of lead, a carbonate of that metal would have been formed, which we have already said to be poisonous.

MARKS OF TIME.

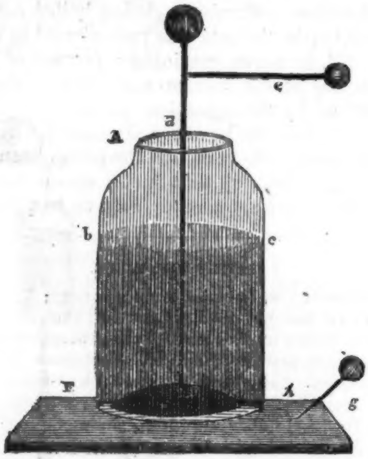
An infant boy was playing among flowers;
Old Time, that unbribed register of hours,
Came hobbling on, but smoothed his wrinkled face,
To mark the artless joy and blooming grace
Of the young cherub, on whose cheek so fair
Time smiled, and pressed a rosy dimple there.
Next Boyhood followed with his shout of glee,
Elastic step, and spirit wild and free
As the young fawn, that scales the mountain height,
Or new-fledged eaglet in his sunward flight;
Time cast a glance upon the careless boy,
Who frolicked onward with a bound of joy!
Then Youth came forward, his bright glancing eye
Seemed a reflection of the cloudless sky!
The dawn of passion in its purest glow,
Crimsoned his cheek, and beamed upon his brow,
Giving expression to his blooming face,
And to his fragile form a manly grace;
His voice was harmony, his speech was truth—
Time lightly laid his hand upon the youth.
Manhood next followed, in the sunny prime
Of life's meridian bloom; all the sublime
And beautiful of nature met his view,
Brightened by Hope, whose radiant pencil drew
The rich perspective of a scene as fair
As that which smiled on Eden's sinless pair!
Love, fame, and glory, with alternate sway,
Thrilled his warm heart, and with electric ray
Illumed his eye, yet still a shade of care,
Like a light cloud that floats in summer air,
Would shed at times a transitory gloom,
But shadowed not one grace of manly bloom.
Time sighed, as on his polished brow he wrought
The first impressive line of care and thought.
Man in his proud maturity came next;
A bold review of life, from the broad text
Of Nature's ample volume! He had scanned
Her varied page, and a high course had planned;
Humbled ambition, wealth's deceitful smile,
The loss of friends, disease, and mental toil,
Had blanched his cheek, and dimmed his ardent eye,
But spared his noble spirit's energy!
God's proudest stamp of intellectual grace
Still shone unclouded on his care-worn face!
On his high brow still sate the firm resolve
Of judgment deep, whose issue might involve
A nation's fate. Yet thoughts of milder glow
Would oft, like sunbeams o'er a mound of snow,
Upon his cheek their genial influence cast,
While musing o'er the bright or shadowy past:
Time, as he marked his noblest victim, shed
The frost of years upon his honoured head.
Last came, with trembling limbs and bending form,
Like the old oak scathed by the wintry storm,
Man in the last frail stage of human life;
Reason's proud triumph, passion's wild control,
No more dispute their mastery o'er his soul!
As rest the billows on the sea-beat shore,
The war of rivalry is heard no more;
Faith's steady light illumes his eye,
For Time is pointing to Eternity! K. A. W.

ELECTRICITY.

No. IX.

THE LEYDEN JAR.

AN arrangement of the Leyden Jar, more convenient, and, as we think, more effective, than that generally adopted, is represented in the annexed figure.



A glass vessel A, of any required size, is coated both inside and outside with tin-foil, to the height *b c*. *d* is a stout brass rod (or tube), supported in the centre of the jar, by one end being secured into a piece of wood, which is hollowed out so as to fit the bottom of the jar, and to which it must be firmly secured with glue or cement. The other end of this rod terminates about six inches above the top edge of the jar, in a ball, either of brass or baked wood; the latter being most preferable. A smaller rod *e*, the length of which, as well as of a similar one *g*, must be determined by the length of the jar, is screwed into *d*, about an inch and a half below the ball. A stand F is provided, consisting of a piece of mahogany, or other hard wood about $1\frac{1}{4}$ inch thick; and to facilitate the discharge of electricity from the jar, that part of the wood on which it is placed, is coated with foil. The wire *g* is screwed into the stand F, and is brought into metallic contact with the outside coating of the jar, by means of a slip of tin-foil, pasted upon the wood at *h*. To insure perfect contact between the inside coating and the rod *d*, the piece of wood, by which the latter is supported, should also have some slips of foil pasted on it; or, if that cannot conveniently be done, the object may be effected by a piece of brass chain. The extremities *e* and *g* terminate in brass balls.

For delicate experiments, it is sometimes necessary to insulate the jar. In that case a stand with glass legs must be provided.

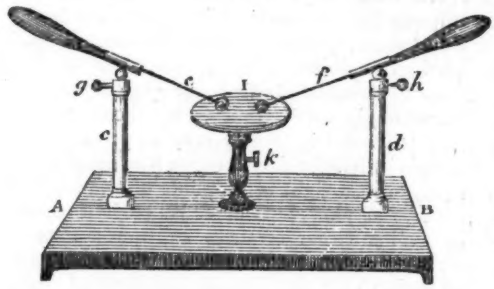
Stands of a circular form, and with raised mouldings, fitting close to the bottom of jars, are better than any other; but they are the most expensive.

For coating jars with tin-foil, we find nothing makes it adhere better than thin paste; a *very* small quantity of which is sufficient for the purpose.

Fitted up in the manner just described, the Leyden Jar is ready for use, and more easily managed than in any other form. Its size should correspond with that of the Electrical machine with which it is to be associated; a knowledge of which is soon acquired by practice. With a powerful machine, (an eighteen or twenty-four inch plate for instance,) one jar containing 350 to 400 square inches of coating (on each side) is sufficient to illustrate an extensive series of electrical phenomena.

But before we begin to experiment with the Leyden jar we must provide a *jointed discharger*, which consists of two slightly-curved brass wires *b*, terminating in balls of the same metal, about three fourths of an inch in diameter, and moving on a joint which is cemented to a glass handl . The action of this instrument is similar to that of a pair of callipers, and is therefore, applicable to jars of any size. It is used for effecting a communication between the inside and outside coatings of jars; enabling the operator to discharge the whole of the accumulated electricity at any moment, and without fear that it will pass through his own body.

Another article of apparatus, equally useful as that just described, is called the *Universal Discharger*. When cheapness is studied, it may be made entirely of well-dried wood, which, with proper care, will answer the purpose quite as well as more costly materials. Its usual form and mode of construction is, however, as follows. A B is a piece of mahogany, say



about 16 inches long by 6 wide, and one inch thick, into which two glass pillars, *c d*, are securely fixed by screws; a plan we recommend whenever it can be adopted, as it adds greatly to the portability, and, in packing, to the security of apparatus. On the top of each of these insulating pillars is a brass cap, to which is connected, by means of a ball-and-socket joint, or some other contrivance affording both a vertical and horizontal motion, a piece of spring tubing, through which passes a brass rod (*e* and *f*) terminating at one end in a glass handle, and at the other in a brass ball, or point, or a pair of forceps, as circumstances may require. *g h* are small brass hooks or balls, by which the opposite sides of a Leyden jar are made to communicate with the rods *e f*. I is a small mahogany table, about four inches in diameter, which is adjusted at any required height, by means of a screw *k*. A small screw-press is sometimes used instead of the table.

By the combined arrangements of this apparatus, a charge of electricity is made to pass through any particular substance which is submitted to its action by being placed on the table, or fixed in any other way most convenient, between the extremities of the rods *e f*.

Returning now to the Leyden jar, we may commence with the following illustration of its principle. Let its inside coating be made to communicate with the (positive) conductor, and which may be effected by placing in contact with it the ball at *e* (see the fig. above); or, if that cannot conveniently be done, they must be connected by a chain. On turning the machine, (and two or three revolutions are sufficient,) the positive electricity excited by it is conveyed to the interior surface of the jar, where it equally diffuses itself over those parts of the glass covered with tin-foil. Now let the operator with one hand touch the ball at *g*, which in the manner already described

communicates with the outside of the jar, and with the other hand the ball at *e*, and at the instant of coming in contact with the latter he will experience a painful sensation in the wrists, elbows, and chest. This is termed an *electric shock*; and although by its suddenness it creates momentary surprise, and is to most persons unwelcome, yet its effects, generally speaking, are very transient. The shock thus given to the human body is occasioned by making the arms and those parts of the body interposed between them the medium of communication in effecting an electrical discharge; the electricity accumulated within the jar making its escape by that course to the outside, and the electrical equilibrium of the jar being thereby instantly restored.

Under the circumstances just mentioned, let it be remembered that the jar must communicate with the earth, that is, it must not be insulated. This is a condition to which we have already alluded; but so important is it in the management of Leyden jars that for a moment we recur to it again.

It must never be overlooked by the electrical student that in all his manipulations he has two opposite kinds (or states) of electricity to deal with, and special provision must always be made for that which presents itself, as it were, unbidden, as well as for that to the production of which his exertions are more immediately directed.

For example: a common (plate) electrical machine fixed in the usual manner, is said to communicate with the earth; because, the table being in contact with the floor, the floor with the walls, and the latter with the earth, there is no difficulty in obtaining a supply of electricity from that inexhaustible storehouse. But let us suppose the same machine to be insulated, that is, cut off from electrical contact with the earth, by means of a stand or table supported on glass legs, and we then find it impossible to obtain from it any great quantity of electricity; for the rubbers being soon exhausted, the action of the machine, at first very feeble, eventually ceases. On connecting the machine by a chain, or other good conductor, with the floor or wall of the building, a supply of electricity will however be immediately obtained.

Precisely the same conditions as are here indicated, must be observed when, for any particular purpose, we wish to accumulate and to retain electricity in bodies; as in a Leyden jar for instance. We will suppose a jar to be in a perfectly neutral state; that is, to contain a certain portion of electricity which it has, in common with other surrounding objects, received from the earth or the atmosphere. We wish this jar to become the depository of a quantity of electricity, much greater than that which it ordinarily contains; and to effect our object, we place the coating on its inner surface in metallic contact with the electrical machine; and then, if the coating on the outside of the jar be in communication with the earth, by working the machine the jar will receive the accumulated charge; but if the outside of the jar do not communicate with the earth, no electricity will pass from the machine to the inside.

Hence therefore we conclude, that if the terms *positive* and *negative* denote two distinct *kinds* of electricity, that kind, whichever it may happen to be, rendered active by the agency of a machine, can be accumulated and retained in no other way than by the simultaneous accumulation and retention of a similar quantity of the opposite kind; the latter presenting itself without any effort on the part of the operator. Or if *positive* and *negative* be supposed to imply distinct and opposite *states* of electrical excitation, the former answering to its excess, and the latter to its deficiency, then is it manifest that one side of the Leyden jar can be made to receive *more* than its ordinary share only when means are provided for the simultaneous escape of a similar quantity from the other side, which will consequently contain *less* than it did before its electrical equilibrium was disturbed.

The following experiment will illustrate what we have been saying, and, as we hope, render intelligible a subject which, to beginners, is generally difficult and perplexing. *b* and *c* are Leyden jars, as nearly as possible of the same size, and similarly fitted up. *a* is an insulating stand, to the top of which one of the jars, *b*, is attached. The other jar is not connected with the stand, and, in the experiment we are going to describe, it must be placed on the table.

If the knob of the mounted jar be brought near the conductor, as represented in the figure, and that of the other placed at the same distance, say, about half an inch, from the end of the projecting brass rod, which is in metallic contact with the outside coating of the jar *b*; on working the machine it will be seen that whenever a spark passes from the conductor to the inside of *b*, at the very same instant a similar spark appears to leave the outside of *b*, and pass to the inside of *c*; and after a few turns of the machine, both jars will be equally charged. Having by means of the discharging rod (see page 116) restored the electrical equilibrium of both jars, and which we recommend should always be done, as the surest protective against accidental shocks, before any other experiment is attempted, let the jar *b* be restored to its former position near the conductor; when, on turning the machine, it will be found that no sparks will pass from the conductor to the jar, and on examining the latter, it will be manifest that no charge has been communicated to it. Let everything remain as just described, excepting that the projecting rod be made to communicate with the earth, and which may be done by attaching to it a piece of chain, or by touching it with the hand. In this case the jar *b* will receive a charge as promptly as if it were standing on the table.

It is a wise, a salutary, and a laudable provision of the church's discipline, that she sets apart, and consecrates, by solemn religious rites to God's glory, the places which she intends for his worship; and by outward signs of decency and reverence, of majesty and holiness, impresses them with an appropriate character, which, whilst it redounds to the honour of God, operates also with no mean or trivial influence on the minds of His people. Connected with this character, and in some degree generated by it, together with an awful veneration for the great Proprietor, a certain secret sense of serene and holy pleasure is diffused over the pious and meditative mind, as soon as the feet cross the threshold which separates the house of God from common places. We feel with delight that we are on "holy ground;" and a still small voice within, as we draw near to "worship God in the beauty of holiness," answers in the words of the Apostle at the sight of the "excellent glory," "It is good for us to be here."—Bishop Mant.

KEEPING INDEPENDENCE.

The people of the United States of America have but one day in the whole year which they celebrate as a holiday or festival: the day on which, to use an expression of their own, they "keep Independence." This national festival is annually celebrated on the 4th of July, since it was upon that day, in the year 1776, that their famous Declaration of Independence was signed, sealed, and executed, by fifty-five of the people's representatives, from the thirteen revolted provinces, that afterwards formed the confederated republic of the United States. Without canvassing the merits of the American revolution, it will readily be conceded that these said "signers" were bold and intrepid men; who, by thus promulgating this treasonable document, were fearlessly braving the vengeance of their rightful sovereign, the king of Great Britain.

It must not be taken for granted that this festival is celebrated in the old-fashioned forms of kingly governments, or of those ancient countries whose inhabitants conceive the superlative of all enjoyment to consist in "feasting and fiddling," and in getting "royally" intoxicated with wine or strong drink. No such thing! Our modern brethren of the United States reckon upon making their's, "The feast of reason and the flow of soul:" whether they invariably succeed or not is another matter.

The celebration of the 4th of July may be said to be truly *national*, since it is neither confined to the metropolis of the union, to the capital cities of the several states, nor to the whole of the larger towns and cities, for every county throughout their vast extent of territory, celebrates "Independence" in its little county town; while there is scarcely a township (even in the most out-of-the-way settlement) that does not get up a celebration on the annual return of Independence Day. In large towns or cities, public functionaries commonly occupy prominent situations in the processions and pageants; for to them, as a matter of course, belong the arrangements of the chief business of the festival, and hence we find them self-appointed to the principal offices of honour and dignity.

There are two things particularly patronized at these celebrations, namely, "soldiering" and "speechifying." The former for the most part consists in parading awkward companies of raw militia, and oddly-accoutred parties of volunteers. Orations, equally marvellous and "lengthy," are listened to with a becoming reverence and composure, for it would be considered extremely indecorous in the audience to express any audible signs of pleasure or approbation;—dissatisfaction, as a matter of course, being out of the question. It certainly does appear—when we look back to "the days that tried men's souls"—that both these modes, that is "soldiering" and "speechifying," are equally appropriate on these celebrations of Independence; since the soldiers and the legislators (public orators) of '76 both materially contributed, in their respective capacities, towards that independence which the people now celebrate as a great national festival.

Those who muster on these occasions under the title of soldiers, (no matter how inapplicable the term may be,) give proofs of their patriotism in the profuse waste of gunpowder; for in addition to rifles, muskets, and rusty fowling pieces, everything bearing the faintest resemblance to a cannon, mortar, or swivel, is pressed into the service of the young republicans; to proclaim, in voices of thunder, that Independence Day has again returned. Where nothing resembling "big guns" can be had, the store-keepers are applied to for the loan of their 56 lbs. weights; the cavities of which are filled with gun-powder. These weights, however, are rather sorry substitutes for long thirty-sixes, or ten-inch mortars; for the hollow spaces within the said weights are both short and narrow; and, to crown the difficulty, they happen to be destitute of touch-holes. To persons of moderate capacities this would seem an insurmountable obstacle,—whereas with an ingenious Yankee it can hardly be called a difficulty. To witness them loading and priming, for they load first and prime afterwards, one would think they had studied the art of mining and blowing up of rocks; for upon the identical plan of charging and discharging a hole perforated in a solid rock, do they manage their 56 lbs. weights. The recoil, however, is sometimes, as they term it, *considerable*; for if they happen to plug up the cavity a little too tightly, so that it becomes a doubtful matter in which direction the force of the explosion shall escape, even should the struggle terminate in favour of the artificial stoppage giving way, as was intended, the square or conical 56 lbs. weight is sure to recoil in an opposite direction, to a distance quite indefinite, (as if exulting in the principle of universal freedom,) and not unfrequently penetrates the slight wooden frame-work of some startled citizen's dwelling. Fingers, and arms, and legs, and even lives, are commonly sacrificed in the ardour of this species of celebrating independence.

In every assembly, on occasions of this nature, whether in city, town, village, or thinly-inhabited township, an "orator of the day" is appointed, (at some previous meeting,) to hold forth to the assembled cititizens. These orators, as already stated, are appointed at some previous meeting; since it would be absurd to expect that a three or four hours' oration, befitting so distinguished an occasion, should be prepared on the instant; and particularly when they have to be manufactured by persons who are not first rate performers in this sort of speech-work. A month or two is usually allowed for preparation; so that a person of ordinary acquirements may manage to cobble out a speech, (making sundry extracts from old printed "Independence Orations,") which he never attempts at delivering extempore, but reads it from some wagon or popular rostrum, in the best manner he is capable.

The people usually assemble in the open air, or in rude arbours formed of the branches of forest trees. When the meeting has been duly organized, some one, previously appointed, opens the business of the day with a long prayer, which very often appears notoriously out of place. In rural districts "the ladies" join in these celebrations; when cider is plentifully supplied by some calculating farmer at a half-penny per glass; while those who can afford it, and feel disposed to spend their three-pence, are accommodated with a weak infusion of hyson-skin: and this they call celebrating their independence in a patriotic and national manner.

The Passover was observed on the fourteenth day of the month Nisan; on the fifteenth day of the same month commenced the feast of unleavened bread; and on the sixteenth day, that is, "the morrow after the sabbath," the Jews offered up to God the *Omer*, or the sheafs of first fruits of the barley harvest, which was cut and carried into the temple with much ceremony. St. Paul, in speaking of Christ's becoming the first fruits of them that slept, probably beautifully alludes to this observance, which was celebrated on "the morrow after the sabbath," literally, Easter day.—*Notes to Bible Narrative.*

RECREATIONS IN NATURAL PHILOSOPHY.

No. XII. On the Elasticity of Air.

The elasticity of the air is one of its most prominent features. A cushion filled with air yields to the weight of the person sitting upon it, but recovers its form when the weight is removed. A bladder partly filled with air, and exposed to the heat of a fire, will swell out until it bursts. In a boy's pop-gun the air is compressed between two pellets of tow, until such an elastic force is obtained as to overcome the friction of the pellet at the end of the tube: the air, in being released, expands with great force, and thus imparts rapid motion to the pellet. The game of foot-ball derives all its interest from the elasticity of the air enclosed within a horse's bladder. The air-gun is perhaps only an improved pop-gun: the air is strongly compressed in a reservoir, and being suddenly liberated, it projects a bullet with great force. The pea-shooter may perhaps be cited as another instance: the air suddenly blown into the tube imparts a great velocity to the pea. If two pins be thrust at right angles, thus +, through a green pea or a pith ball, it can be supported in the air, apparently upon nothing, by blowing through a piece of tobacco-pipe held in the mouth in a vertical position, and placing the pea a little above the upper end of the pipe. The pea is supported by the current of air propelled through the tube: the points of the pins should be covered with sealing-wax, to prevent any accident. Indeed with a little address the pins may be dispensed with altogether, their only object being to give stability to the pea, and to retain it within certain limits of the end of the tube.

But we must put away our toys, and enjoy a little sober philosophy. Air is perfectly elastic: let us inquire why it is so. This will lead us to a very beautiful and simple law, which regulates the elasticity of aeriform bodies.

All substances which exist upon, in, or about the earth, are included in the general comprehensive term *matter*. Matter exists in three states, viz., the solid state, the liquid state, and the gaseous or aeriform state. Matter is supposed to consist of little round bodies called *atoms*, which are so extremely small that no philosopher has ventured even to guess at their size*. A celebrated microscopic observer tells us that he has found animalculæ so small that he could take up a million of them on the point of a needle; but it is more than probable that an atom of matter is a great deal smaller than one of these million of insects. However, we will not talk further about the size of an atom, since we can arrive at no just idea of it. When these atoms are firmly held together, so as to require great force to separate them, we get a solid: when they are less firmly united, so that by a very slight disturbance we can displace them, we get a liquid. This force of attraction, which unites the atoms of solids and liquids, is called the *attraction of cohesion*, which has already occupied our attention in this course. See *Saturday Magazine*, No. 392. Now this cohesion is altogether absent in airs. If, for example, we put a lump of ice into a small copper boiler, and fasten down the lid, so that nothing can get in or out except heat, (for that gets everywhere, and we cannot confine it,) and then put this boiler on the fire, the solid ice will soon become water. Now in the ice the attraction of cohesion is much stronger than in the water, and by continuing the heat we shall destroy the cohesion altogether; the water will become steam, the particles of which not only have no attraction for each other, but they actually repel each other; and the more so in proportion to the amount of heat contained among them. This repulsion soon becomes so great as to burst the boiler, with a tremendous explosion. Hence the use of safety-valves, the nature and use of which we will consider more particularly in another article.

Now this repulsion among the atoms of aeriform bodies gives us the reason why they are so minutely and so perfectly elastic. They are always seeking to fly off from each other, so much so that if we were to let a quart of air into an exhausted† vessel, capable of holding a million quarts, this vessel would not only be filled, but the air would press in all directions upon its internal surfaces in their attempt to extend themselves further. Nay, this struggle is constantly going on in every vessel which is full of air, such as we are in the habit of calling *empty*. In every vessel containing air there is a contest between the enclosed and the external air. The latter seeks to get into the vessel, and the former opposes the entrance; and were it not for this contest many a close vessel full of air would burst, in consequence of the particles or atoms of the enclosed air seeking to extend their limits. But this catastrophe does not occur in consequence of the external air exerting a pressure in all directions of fourteen and a half pounds upon every square inch of surface; but if a thin square glass vessel be firmly and accurately closed, and placed under the receiver of an air-pump, it will burst when the pressure of the external air is removed. When the external air is present it does not burst, because the enclosed air is as dense as that without, and therefore exerts as great a pressure in all directions, and these two pressures, the internal and the external, being equal, no effect ensues.

It may probably be asked why the air, exerting, as it does, so great a repulsive force among its own particles, does not fly off into space, where we may suppose each atom would have room enough to be solitary, without any intrusion on the part of its companion atoms. The reason is, that all the atoms of air being subject to the attraction of gravitation, which confines them within certain limits of our earth, that attraction is so much stronger than the repulsion among the aerial particles. The nearer the air is to the surface of the earth, the more is it subject to gravity; and, besides this, the lower strata of air have to bear up against this attraction for the upper strata, and accordingly we find that the air at the surface of the earth is more dense than at the tops of high mountains, and consequently it exerts a less pressure in the latter than in the former case.

The beauty of this admirable contrivance is well calculated to awaken within us a lively sense of the wisdom of the great Creator, not only on account of the Divine skill to contrive, to execute, and to preserve the stability of His works, when contrived and executed, but also in allowing us, by the study and contemplation thereof, to understand them;

> To grow familiar, day by day,
> With His conceptions; act upon His plan,
> And form to His the relish of our souls.

The perfect elasticity of airs has enabled philosophers to arrive at a very beautiful and simple law, viz., that a volume or bulk of any gas depends upon the pressure which it supports, and that, at the same temperature, all gases occupy the same volume under the same pressure. But this law is so very important that we must devote a whole article to its demonstration.

* Dr. Thomson has shown by experiment and calculation that an atom of lead does not weigh *more* than one 310,000,000,000th of a grain, and an atom of sulphur not *more* than one 2015,000,000,000th of a grain.

† A vessel is said to be exhausted when it is deprived of air. A vacuum or empty space then exists within the vessel.

ON WRITING MATERIALS, (*concluded.*)

No. XI.

PEN-KNIVES.—The extraordinary demand for steel pens within the last few years, in which the aid of a pen-knife is not called for, would have induced us to think that the use of quill pens must have greatly diminished, and that pen-knives must likewise have become much less in request. But such does not appear to be the case. We rejoice to find that both quill pens and steel pens are manifesting their utility by increasing in their supply. Long may this continue, and long may the pen be the pioneer for preparing the way for improvements in the ages that are to come.

The manufacture of the pen-knife is but one among a vast variety of processes which constitute cutlery. We may probably hereafter enter somewhat fully upon the iron manufacture generally, and will therefore, at present, give merely the outlines of the processes necessary for the manufacture of a pen-knife.

Sheffield is the great workshop which supplies almost all the world with knives. The hammering of the steel bar which is to form the blade, is carried on in the *smithy*. A boy is employed to keep several bars of steel heated, or being heated at one time; and he hands them to the striker or hammer-man, one at a time, so that he is kept constantly at work. A pen-knife-blade is formed by two heatings. In the first place, that part which we call the blade is fashioned by hammering, and then chopped off the end of the rod. It is then again heated in the forge, taken up by a pair of tongs, and the part which is called the *tang* is formed; this tang is the part by which the workman holds it while grinding the blade, and which is ultimately inserted in the handle. The whole is then smithed, or smartly hammered after it has ceased to be soft, in order to close the pores, and produce the greatest possible degree of density. The nail-mark—used when "opening" the pen-knife—and the maker's name, &c., having been struck upon it, it is ready for hardening. The steel springs for the back, and the iron casings for the inner sides of the handle, are made by workmen ranking a degree lower than the blade makers.

When the blade is properly hammered, it is next hardened and tempered,—processes which, though extremely simple in themselves, require the nicest tact and judgment, as upon them the excellence of the future knife greatly depends. Steel is commonly hardened by being plunged, while red-hot, into cold water, and afterwards tempered by being heated until the surface assumes a particular tinge, varying from a light straw colour to a deep blue, according to the nature of the instrument which is being made.

After the blade has been hardened, it is, in most cases, carried directly to the grinding mill, or wheel, for the purpose of being ground. Before the extensive introduction of steam power, the grinding wheels were turned by water; but now steam has usurped the place of water, in this as in many other instances. The grinding stones revolve on horizontal axes, and are of various sizes for different kinds of work. The blade is frequently wetted, and applied to the stone in a way which may be easily conceived. The pen-knife when ground, is worked on a trundle or *glazer*, which is a wooden wheel about four feet in diameter and two inches thick. On the edge of this wheel is a coating of soft metal, consisting of lead and tin, about an inch in thickness; and on this, powdered emery is applied.

The next process is that of *polishing* or *buffing* the blade, which is done on a wheel similar to that last described, except that the surface of the wheel is covered with buff leather instead of emery. On this leather some very fine polishing powder is applied, and the blade polished.

The blade now passes into the hands of the workman who is to finish it and finally place it in its handle. The workman wears a breast-plate in front of his body, fastened round him with straps: the breast-plate contains a piece of steel with several small indentations. These are to receive the blunt end of a borer which is to make small holes for rivets, and for the hole for the pin upon which the blade works at the joint. An ingenious instrument called the *boring-stick*, gives a rapid rotatory motion to the borer, which is a sharp instrument, and thus enables it to penetrate the metal applied against the sharp end of the borer.

The materials employed for handles are almost innumerable. Gold, silver, ivory, mother of pearl, tortoise-shell, horn, bone, cast-iron, &c., are employed, according to the costliness of the article. The forms of handles are almost as various as their materials, as is well known.

When the blade and the handle, with its metallic lining, spring, &c., are properly made and the holes bored, the whole is pinned together, (loosely at first, till, all the parts being exactly fitted, the knife is found to work properly,) with pieces of wire, and rivetted with the hammer. The sides of the handle, if of horn, ivory, or shell, are then filed and scraped, and then polished on a wheel covered with buff leather. A small shield, either of silver or some other metal, is frequently inserted in one side of the handle. The groove or depression which is to receive this shield is made in a manner somewhat resembling that in which the holes are bored.

We may state, as an instance of the rapidity with which pen-knives must be made, that we have purchased one at a cutler's in London for *three-halfpence.* The handle was of cast-iron, and the rivets and spring firm and complete. It is needless to say, that as a cutting instrument its merits were but slight; but we mention it as a proof of what may be done by division of labour and the application of machinery. The raw material, the workmen's wages, the carriage to London, and the profit of the shopkeeper, must all be paid out of this three-halfpence!

Pounce.—Writing masters are in the habit of rubbing the powder of scuttle-fish, or of gum sandarach, upon writing-paper, in order to make it less absorptive of the ink. This gives a sharp, precise, and determinate character to the writing. For those who are curious in the art of the pen, pounce is very useful in concealing errors which have been scratched out with a pen-knife. The action of the latter upon paper is to remove the size and to allow the ink to diffuse itself into an ugly blot: this, however, is altogether prevented by the application of pounce.

OF CRIMES AND PUNISHMENTS.

IF those whom the wisdom of our laws has condemned to die, had been detected in their rudiments of robbery, they might, by proper discipline, and useful labour, have been disentangled in their habits; they might have escaped all the temptations to subsequent crimes, and passed their days in reparation and penitence; and detected they might all have been, had the prosecutors been certain their lives would have been spared. I believe every thief will confess, that he has been more than once seized and dismissed; and that he has sometimes ventured upon capital crimes, because he knew, that those whom he injured, would rather connive at his escape than cloud their minds with the horrors of his death.—JOHNSON.

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